

Code for Flow-consistent identification of governing equations from sparsely sampled measurements

HANDI_code

Subfolders	Description
Canonical nonlinear system	Data for training, results, codes for identifying Canonical nonlinear system, comparison, ablation and plotting
Benchmark_examples	Data for training, results, codes for identifying benchmark examples, comparison and plotting
Real-world_examples	Data for training, results, codes for identifying real-world examples, comparison and plotting

Canonical nonlinear system

This directory contains five subfolders: four correspond to distinct simulated systems used for continuous-time dynamical system identification, and one contains utilities and scripts for generating plots.

Subfolders	Description
Fixed_Point	Data, results, codes for identifying Fixed point system, ablation study, comparison and plotting
Limit_Cycle	Data, results, codes for identifying Limit cycle system, ablation study and plotting
Vanderpol	Data, results, codes for identifying Van der Pol oscillator, comparison and plotting
Duffing	Data, results, codes for identifying Duffing oscillator, comparison and plotting
Mass_spring_damper	Data, results, codes for identifying mass-spring-damper system, comparison and plotting
plot	Codes to draw trajectory graphs, phase portraits, characteristic function graphs, eigenvalue graphs, and NRMSE graphs

The contents of each subfolder within the Canonical Nonlinear System directory are described in detail below, including all constituent files and nested subfolders.

Subfolders	Description
data	Data for training at different sampling rate
ablation	Codes for ablation study

mse and acr	Code for computing the MSE and ACR of the HANDI and baseline models
results	The NRMSE results, identified equations, model weights, and model parameter files for HANDI and baseline models trained under different sampling rates
HANDI.py, EDMD.py, gEDMD.py, SINDy.py, SR3.py, WSINDy.py, PSE.py	Implementation of the HANDI, EDMD, gEDMD, SINDy, SR3, WSINDy, and PSE methods

Benchmark examples

This directory comprises four subfolders, each dedicated to a specific benchmark example for system identification. These subfolders are detailed in the table below.

Subfolders	Description
Id6_chemical	Data, results, codes for identifying chemical autocatalysis example, comparison and plotting
Id9_language	Data, results, codes for identifying language death example, comparison and plotting
Id31_SIR	Data, results, codes for identifying SIR epidemic example, comparison and plotting
Id39_glycolysis	Data, results, codes for identifying glycolytic oscillator example, comparison and plotting

The contents of each subfolder within the benchmark examples are described in detail below, including all constituent files and nested subfolders.

Subfolders	Description
data.npy	Original benchmark dataset in NumPy format
data_process	Code for downsampling and adding controlled noise (e.g., 1%, 5%, 10%) to the original data, processed data for training
mse	Code for computing the MSE of the HANDI, SINDy, and EDMD models
results	The MSE results, identified equations, model weights, and model parameter files for HANDI, SINDy, and EDMD trained under different sampling rates
plot	Codes for creating trajectory plots
HANDI.py, EDMD.py, gEDMD.py, SINDy.py, SR3.py, WSINDy.py, PSE.py	Implementation of the HANDI, EDMD, gEDMD, SINDy, SR3, WSINDy, and PSE methods

Real-world examples

This directory comprises four subfolders, each dedicated to a specific real-world example for system identification. These subfolders are detailed in the table below.

Subfolders	Description
Inverted_Flag	Data, results, codes for identifying inverted flag flapping example, comparison and plotting
Neural_integration	Data, results, codes for identifying neural integration example, comparison and plotting
Pendulum	Data, results, codes for identifying pendulum dynamics example, comparison and plotting
Wheel_shimmy	Data, results, codes for identifying wheel shimmy dynamics example, comparison and plotting

The contents of each subfolder within the real-world examples are described in detail below, including all constituent files and nested subfolders.

Subfolders	Description
HANDI.py	Implementation of the HANDI method
data.npy	Original real-world dataset in NumPy format
plot	Codes for creating trajectory plots and phase diagrams
data_process	Code for data trimming and normalization
mse	Code for computing the MSE of the HANDI, SINDy, and EDMD models
results	The MSE results, identified equations, model weights, and model parameter files for HANDI, SINDy, and EDMD trained under different sampling rates